NASA SBIR/STTR Technologies

Multi-Use Non-Intrusive Flow Characterization System (FCS)

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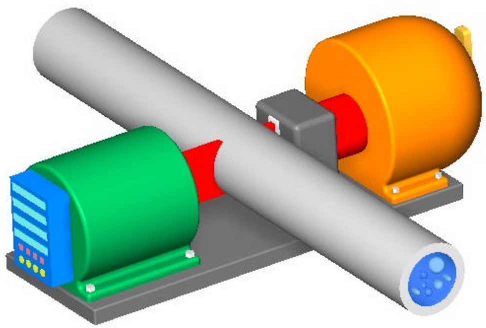
Identification and Significance of Innovation

The innovation is a Multi-Use Non-Intrusive Flow Characterization System (FCS) for densified, normal boiling point, and two-phase cryogenic flows, capable of accurately measuring several fluid parameters in real-time. Cryogenic fluids are ubiquitous in the aerospace industry. Their low temperatures inherently promote heat transfer from the ambient environment which often results in two-phase flows that cannot be adequately characterized by existing instrumentation. FCS was originated to address this issue and greatly enhance the quantification, reliability, safety, and autonomous operations of propulsion test operations. FCS handles both transient and steady state flows, and is anticipated to have a fast response time. The technology can non-intrusively operate in the following five modes: 1) on-line analysis of fluid mixtures; 2) mass flow rate measurement; 3) temperature measurement; 4) fluid conditioning and health monitoring; and 5) model validation for a cryogenic or non-cryogenic fluid flow.



Multi-Use Non-Intrusive Flow Characterization System (FCS)

Technical Objectives

- Define the FCS systems requirements in terms of accuracy, installation, safety, and maintenance such that it will best meet NASA's needs.
- Design and activate the Phase I FCS system.
- Conduct laboratory testing to experimentally investigate the FCS design features and refine its performance.
- Establish the delivered performance of the FCS in higher-pressure, thicker walled cryogenic systems by conducting single and two-phase LOX experiments.
- Evaluate the technical feasibility and performance of the five major FCS application areas.
- Create a preliminary design for the Phase II prototype commercial FCS.

Work Plan

Task 1. System Requirements Definition
Task 2. Pre-Prototype FCS Design
Task 3. Laboratory Testing
Task 4. Cryogenic Flow Experiments
Task 5. Applications Assessment
Task 6. Preliminary Phase II Design
Task 7. Reporting

NASA Applications

Accurate, non-intrusive cryogenic flow sensors have been highly sought after for decades. There is a fundamental need for measurement of densified, normal boiling point, and two-phase cyrogenic flows for ground based, space, and ISRU applications. There are several NASA facilities and programs at SSC, KSC, GRC, MSFC, JSC, and JPL that could benefit from successful development of FCS where it could find application in: ground based flow metering and control, fluid conditioning and health monitoring, analytical model validation, applied fluid physics and microgravity research, in-space cryogenic fluid management and mass quantity gauging, and planetary operations.

Non-NASA Applications

There is a large market for an accurate, non-intrusive cryogenic flow sensor capable of handling a wide variety of flows. Commercial aerospace companies and DoD have similar FCS applications requirements to NASA, including: ground-based flow metering and control, fluid conditioning and health monitoring, analytical model validation, applied fluid physics and microgravity research, in-space cryogenic fluid management and in-space mass quantity gauging. Outside of the aerospace community, FCS has commercial potential in the paper, refrigeration, cryogenics, automotive and many other industries. Examples of FCS applications include: determining when a system has been sufficiently chilled down; measuring and diagnosing heat leaks into fluid flow networks; and accurate metering and controlled delivery.

Contact Information

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